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IS : 9000 (Part 1) - 1988
(Reaffirmed 2004)

Indian Standard

BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTRONIC AND ELECTRICAL ITEMS

PART 1 GENERAL

(First Revision)

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Gr 6

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Indian Standard

BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTRONIC AND ELECTRICAL ITEMS

PART 1 GENERAL

(First Revision)

0. FOREWORD

0.1 This Indian Standard (Part 1) (First Revision) was adopted by the Bureau of Indian Standards on 21 July 1988, after the draft finalized by the Environmental Testing Procedures Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 This standard was first published in 1977. This revision has been undertaken to line up this standard with IEC Pub 68-1 (1982). Basic environmental Testing Procedures, Part 1 : General and Guidance, issued by the International Electrotechnical Commission.

0.3 IS : 9000 contains fundamental information on environmental testing procedures and severities of tests. It is intended to be used in those cases where a relevant specification for a certain type of component or equipment has to be prepared so as to achieve uniformity and reproducibility in the testing procedures for the environmental testing of these items.

The expression 'environmental conditioning' or 'environmental testing' covers the natural and artificial environments to which components or equipment may be exposed so that an assessment can be made of their performance under conditions of use, transport and storage to which they may be exposed in practice.

The requirements for the performance of components or equipment exposed to environmental conditioning are not covered by this standard. The relevant specification for the item under test defines the allowed performance limits during and after environmental testing.

When drafting a relevant specification or purchase contract, only those tests should be specified which are necessary for the relevant components or equipment taking into account the technical and economic aspects.

0.4 The groups of basic tests comprising subsequent parts of IS : 9000 will be designated by upper case letters in their future revisions as follows:

Test A : Cold
Test B : Dry heat
Test C : Damp heat (steady state)
Test D : Damp heat (cyclic)
Test E : Impact (for example, shock and bump)
Test F : Vibration
Test G : Acceleration (steady state)
Test H : Storage (*see* Note)
Test J : Mould growth
Test K : Corrosive atmospheres (for example, salt mist)
Test L : Dust and sand
Test M : Air pressure (high or low)
Test N : Change of temperature
Test P : Flammability
Test Q : Sealing (including panel sealing, container sealing, and protection against ingress and leakage of fluid)
Test R : Unallotted
Test S : Radiation (for example, solar or nuclear)
Test T : Soldering (including thermal shock from soldering)
Test U : Robustness of terminations
Test V : Acoustic noise
Test W : Unallotted
Test X : Unallotted
Test Y : Unallotted
Test Z : Combined tests

NOTE — No testing procedure for normal storage is included in IS : 9000 series because of the difficulty of specifying conditions other than artificial ones which would give reproducible results.

However, attention is drawn to the fact that such a test may be necessary for certain components or equipment. This requirement should then be covered in the relevant specification.

If appropriate, any test may be annotated as 'primarily intended for component' or 'primarily intended for equipment'.

0.4.1 To provide for future expansion and to maintain consistency of presentation, each test section will be subdivided. The subdivisions are identified by the addition of a second letter (lower case), for example:

Test U : ROBUSTNESS OF TERMINATIONS
Test Ua : Tensile
Test Ub : Bending
Test Uc : Torsion
Test Ud : Torque

This subdivision will be made even though only one test is published and no further tests are immediately contemplated in the relevant section.

NOTE — In order to avoid confusion with figures, the letters I and O will not be used.

0.5 Components or equipment which have been subjected to the tests listed in **0.6** should not be regarded as 'new components' or 'new equipment', unless otherwise agreed between the manufacturer and the purchaser.

0.6 The difference in environmental testing procedures for component type items and equipment type items are fast disappearing in the context of technological developments. It is, therefore, found necessary to have uniform testing procedures, wherever possible. This series of standards on environmental testing procedures (IS : 9000) has been prepared with this objective. This is also in line with the principle adopted by IEC/TC 50 Environmental Testing, in developing unified series of standards on environmental testing procedures by the International Electrotechnical Commission.

0.6.1 However, it has been found desirable to give some guidance regarding applicable severities for component type items and equipment type items in case of certain tests to help the users of this standard, and the required information is given in Table 1. In view of the fast disappearing difference between the two, care should be exercised in using the table. A column on additional severities has also been included from which choice should be made for other severities to be adopted either for component type or equipment type items, depending upon the intended application.

0.7 This standard is largely based on IEC Pub 68-1 (1982) Basic Environmental Testing Procedures, Part 1 : General and guidance, issued by the International Electrotechnical Commission (IEC).

0.8 In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

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*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard (Part 1) covers general conditions applicable to environmental testing and lists a series of environmental test procedures, and their severities designed to assess the ability of electronic and electrical items to perform under expected conditions of service.

1.1.1 Although primarily intended for such applications, this standard may be used in other fields, where desired.

1.1.2 Other environmental tests, specific to the individual types of specimen, may be included in the relevant specifications.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Test — The complete series of operations covered by any one heading will normally consist of the following:

a) Pre-conditioning (where required),
b) Initial examination and measurements (where required),
c) Conditioning,
d) Recovery (where required), and
e) Final examination and measurements.

Intermediate measurements may be required during conditioning and/or recovery.

NOTE — The tests covered by this standard may in themselves consist of a series of operations in order to determine the effect of such a test or series of tests on an item.

2.1.1 *Pre-conditioning* — The treatment of an item with the object of removing or partly counteracting the effects of its previous history, where called for, it is the first process in the test procedure.

2.1.2 *Conditioning* — The exposure of an item to an environmental condition in order to determine the effect of such a condition on it.

2.1.3 *Recovery* — The treatment of an item, after conditioning, in order that the properties of the item may be stabilized before measurement.

2.2 Item — A component, equipment or other item designated to be tested in accordance with the procedures of this standard.

NOTE — The term item covers any auxiliary parts or systems that are integral functional features of the item, for example, cooling, heating, mechanical isolators, etc.

2.3 Heat-Dissipating Item — For the purpose of climatic testing, an item is considered heat-dissipating when the hottest point on its surface, measured in free air conditions, is more than 5°C above the ambient temperature of the surrounding atmosphere after temperature stability has been reached.

NOTE — Measurements required to prove that an item can be regarded as non-heat-dissipating can be made in normal laboratory conditions if care has been taken that no outside influence (for example, draughts, or sunlight) affects the measurements. In the case of large or complicated items, it may be necessary to make measurements at several points.

2.4 Free Air Conditions — Conditions within an infinite space where the movement of the air is affected only by the heat-dissipating item itself and the energy radiated by the item is absorbed.

NOTE — Theoretically, this definition does not apply to the case where the heating of the item is by direct radiation. In practice, however, the definition may be used also for this case.

2.5 Relevant Specification — A statement of a set of requirements to be satisfied by a product or material indicating the procedure necessary to determine whether the requirements given are satisfied.

2.6 Ambient Temperature

NOTE — In applying these definitions, guidance should be sought from IS : 9001 (Part 2)-1977*.

2.6.1 *Non-heat-dissipating Items* — Ambient temperature is the temperature of the air surrounding the item.

2.6.2 *Heat-Dissipating Items* — For a heat-dissipating item in free air conditions, the ambient temperature is the temperature of the air at such distance from the item that the effect of the dissipation is negligible.

NOTE — In practice, the ambient temperature is taken as the average of temperatures measured at a number of points in a horizontal plane situated 0 to 50 mm below the item at half the distance between the item and the wall of the chamber or at 1 m distance, whichever is less. Suitable precautions should be taken to avoid heat radiation affecting these measurements.

2.7 Surface Temperature (Case Temperature) — The temperature measured at specified point(s) on the surface of the item.

2.8 Temperature Stability — Temperature stability has been reached when the temperatures of all parts of the item are within 3°C or as otherwise specified in the relevant specification of their final temperature.

NOTE 1 — For non-heat-dissipating items, the final temperature will be the mean (in time) temperature of the chamber in which the item is placed. For heat-dissipating items, it is necessary to make repeated measurements to determine the interval of time for the temperature to change 3°C or as otherwise specified in the relevant specification. Temperature stability has been reached when the ratio between two consecutive time intervals exceeds 1·7.

NOTE 2 — Where the thermal time constant of the specimen is short compared with the duration of the exposure to a given temperature, no measurement is needed. Where the thermal time constant of the specimen is of the same order as the duration of the exposure, checks should be made to ascertain:

a) that non-heat dissipating items are within the required limit of the mean (in time) temperature of the atmosphere in which the item is placed;

b) that for heat-dissipating items, the ratio between two consecutive time intervals exceeds 1·7 when repeated measurements are made to determine the interval of time required for the temperature to change by 3°C or as otherwise specified in the relevant specification.

NOTE 3 — In practice, it may not be possible to make direct measurements of the internal temperature of the item. A check may then be made by measuring some other parameter which is temperature-dependent and for which the temperature dependence is known.

2.9 Chamber — An enclosure or space in some part of which the specified conditions can be achieved.

2.9.1 *Working Space* — That part of the chamber in which the specified conditions can be maintained within the specified tolerances.

2.10 Combined Test — A test in which two or more test environments act upon the test item simultaneously.

NOTE — Measurements are usually taken at the start and at the end of the test.

2.11 Composite Test — A test in which the test item is exposed to two or more test environments in close succession and for which the times of intervals between the exposures to different test environments are defined precisely, because they have a significant effect on the test item.

Pre-conditioning and recovery or stabilization periods are usually not performed between each exposure.

NOTE — Measurements are usually taken prior to the start of the first exposure and at the conclusion of the last exposure.

2.12 Sequence of Tests — A sequence in which the test item is exposed successively to two or more test environments.

The times of intervals between the exposures to different test environments are such that they normally have no significant effect on the test item.

Pre-conditioning and recovery periods are usually performed between each exposure.

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*Guidance for environmental testing: Part 2 Cold and dry heat tests.

NOTE — Measurements are usually taken and after each exposure, the final measurement of one test being the initial measurement of the next.

3. OBJECT

3.1 The object of this standard is to provide uniform and reproducible environmental (climatic and mechanical robustness) testing procedures to those preparing specifications for components and equipment.

3.2 These testing procedures have been based upon available national and international engineering experience and judgement, and are designed to provide information on the following properties of components and equipment:

a) Ability to operate within specified limits of temperature, pressure, humidity, mechanical stress or other environmental conditions and certain combinations of these conditions; and

b) Ability to withstand storage and transport.

3.3 The tests in this standard permit the performance of sample components or equipment to be compared. To assess the overall quality or useful life expectancy of a given production lot, the test procedures should be applied in accordance with a suitable sampling plan and may be supplemented by appropriate additional tests, if necessary.

3.4 To provide tests appropriate to the different intensities of an environmental condition, some of the test procedures have a number of degrees of severity. These different degrees of severity are obtained by varying the time, temperature, air pressure or some other determining factor separately or in combination.

3.5 This standard should be used in conjunction with the relevant specification which will define the tests to be used, the required degree of severity for each of them, their order, if relevant, and the permissible performance limits.

3.5.1 The relevant specification will also specify the deviations in testing procedure which may be inevitable when applying the tests to the specimens under consideration and it will further specify any special procedures which may be required.

3.5.2 In the event of conflict between this basic standard and the relevant specification, the latter shall apply.

3.5.3 Test facilities having the size, construction and performance necessary for the proper application of the tests are sometimes specified in the relevant specification. In other cases, where required by the purchaser, the capability of the test equipment shall be agreed between the manufacturer and the purchaser.

4. STANDARD ATMOSPHERIC CONDITIONS

4.0 The following standard atmospheric conditions are specified for the purpose shown.

4.1 Standard Atmospheric Conditions for Reference — If the parameters to be measured depend on temperature and/or pressure, and the law of dependence is known, the values shall be measured at the conditions specified in **4.3** and, if necessary, be corrected by calculation to the standard reference atmosphere of:

a) temperature, 20°C; and

b) air pressure, 101·3 kPa.

NOTE — No requirement for relative humidity is given because a correction by calculation is generally not possible.

4.2 Standard Atmospheric Conditions for Referee Tests — If the parameters to be measured depend on temperature, pressure and humidity, and the law of dependence is unknown, the measurements may be made under the following conditions :

Temperature °C	*Relative Humidity* percent	*Air Pressure* kPa
Electronic items		
25 ± 1	48 to 52	86 to 106
Electrical items		
27 ± 1	63 to 67	86 to 106

When the temperature of measurement differs from the above temperature, suitable limits for the characteristics values shall be agreed between the purchaser and the manufacturer.

NOTE — The relative humidity may be disregarded where it has no influence on the test results.

4.3 Standard Atmospheric Conditions for Testing

4.3.1 The standard range of atmospheric conditions for carrying out measurements and tests is as follows:

Temperature	*Relative Humidity*	*Air Pressure*
15 to 35°C	45 to 75 percent	86 to 106 kPa

4.3.2 Where it is impracticable to carry out measurements under the standard atmospheric conditions for testing, a note to this effect, stating the actual conditions, shall be added to the test report. The relative humidity may be disregarded where it has no influence on the test results.

4.3.3 The temperature and humidity shall be substantially constant during a series of measurements carried out as a part of one test on one item.

NOTE — For large items, in test rooms where it is difficult to maintain the temperature within the limits specified above, the range may be extended beyond these limits either to 10°C or up to 40°C by mutual agreement.

4.4 Recovery Conditions — After the test conditioning period and before making the final measurements, the items should be allowed to stabilize under the ambient temperature at which the measurements are to be made.

The 'controlled recovery conditions' (*see* **4.4.1**) shall be applied if the electrical parameters to be measured are affected by absorbed humidity or surface conditions of the items and change rapidly, for example, if the insulation resistance rises considerably within approximately 2 h after removal from a humidity chamber.

If electrical parameters of the items affected by absorbed humidity or surface conditions do not vary rapidly, recovery may be carried out in the conditions prescribed for standard atmospheric conditions for testing as given in **4.3**.

If the recovery and measurement are performed in separate rooms, the combination of temperature and humidity conditions shall be such that condensation on the surface of the items does not occur when the item is transferred to a measurement room.

Recovery period is to be stated in the relevant specification if different from that given in the appropriate part of IS : 9000*.

4.4.1 *Control Recovery Conditions (Previously Referred to as 'Standard Recovery Conditions')* — The controlled recovery conditions are as follows:

Temperature — Actual laboratory temperature ± 1°C subject to the over-riding requirements of **4.3**, that is, within + 15 to 35°C.

Relative humidity — 73 to 77 percent.

Air pressure — 86 to 106 kPa.

Recovery period — to be stated in the relevant specification, if different from that given in the appropriate part of IS : 9000*.

NOTE — These controlled recovery conditions may also be used for pre-conditioning.

4.4.2 The item shall be placed in the recovery chamber within 10 min of the completion of the conditioning procedure. Where the relevant specification requires measurement to be made immediately after the recovery period, these measurement shall be completed within 30 min of removal from the recovery chamber. Those characteristics which are expected to change most rapidly after the item is removed from the recovery atmosphere shall be measured first.

4.4.3 The temperature of the recovery chamber shall not deviate from the laboratory ambient temperature by more than 1°C to prevent moisture being absorbed or lost by the item when removed from the recovery chamber. This necessitates the use of a chamber having good thermal conductivity in which the humidity can be closely controlled.

4.4.4 If, for specific cases, different recovery conditions are necessary, they shall be specified in the relevant specification.

4.5 Standard Conditions for Assisted Drying

4.5.1 Where assisted drying is required before commencing a series of measurements, the following conditions shall be used for 6 h, unless otherwise specified by the relevant specification:

Temperature	*Relative humidity*	*Air pressure*
55 ± 2°C	Not exceeding 20 percent	86 to 106 kPa

4.5.2 If it is impracticable to carry out assisted drying under standard conditions for assisted drying, a note to this effect stating the actual conditions, shall be added to the test report.

4.5.3 When the specified temperature for the dry heat test is lower than 55°C, the assisted drying shall be carried out at that lower temperature.

5. USE OF TESTING PROCEDURES

5.1 As required by the relavant specification, the testing procedures may be used for type approval, batch sampling, quality control or any other purpose.

6. STANDARD CLIMATIC SEQUENCE

6.1 In order to provide a standard sequence of climatic tests primarily intended for components, the cold, dry heat, low air pressure and accelerated damp heat conditioning procedures are regarded as interdependent and are referred to as the 'climatic sequence'. The order in which these tests shall be made is as follows:

a) Dry heat;
b) Damp heat, cyclic (first cycle of Test D);
c) Cold;
d) Low air pressure; and
e) Damp heat, cyclic (remaining cycles of Test D).

An interval of not more than three days is permitted between any of these conditioning procedures except when the cold conditioning follows the damp heat (cyclic) where the interval shall be not more than 2 h including recovery. Measurements will normally only be made at the commencement and conclusion of the climatic sequence, except when prescribed during conditioning periods.

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*Basic environmental testing procedures for electronic and electrical items.

7. CLIMATIC CLASSIFICATION

7.1 Where it is desired to adopt a system of climatic classification, it shall be based on the general principles contained in Appendix A. The common part of all systems shall be the climatic categories.

8. APPLICATION OF TESTS

8.1 Unless otherwise specified, tests shall be carried out on items in the 'ready to use' condition, but not switched on. The relevant specification may, where applicable, prescribe that tests shall be carried out on items in the packed condition.

8.2 When the sizes and/or weights of items are such that tests on the complete items are not justified or practicable, the necessary information may be obtained by testing major sub-assemblies separately. Details of the procedures to be followed shall be as given in the relevant specification.

NOTE — This procedure is applicable only to those cases where the sub-assemblies are not subject to mutual influence(s), unless these influences are taken into account.

9. SIGNIFICANCE OF THE NUMERICAL VALUE OF A QUANTITY

9.0 The numerical value of the quantities for the various parameters (temperature, humidity, stress, duration, etc.) given in the basic environmental tests comprising subsequent part of IS : 9000* are expressed in different ways according to the needs of each individual test.

The two cases which most frequently arise are the:

a) quantity is expressed as a nominal value with a tolerance, and

b) quantity is expressed as a range of values.

For these two cases, the significance of the numerical value is discussed below.

9.1 Quantity expressed as nominal value with tolerance.

Examples:

40 ± 2°C

2 ± 0·5 s

93 + 2 percent

— 3 percent

The expression of a quantity as a numerical value indicates the intention that the test should be carried out at the stated value. The object of stating tolerances is to take account of, in particular, the following factors:

a) The difficulties in adjusting some regulating devices and of their drift (undesired slow variation) during the test,

b) Instrumental errors, and

c) Non-uniformity of environmental conditions for which no specific tolerances are given in the test space in which the items under test are located.

These tolerances are not intended to allow latitude in the adjustment of the values of the parameters within the test space. Hence, when a quantity is expressed by a nominal value with a tolerance, the test apparatus shall be adjusted so as to obtain this nominal value making allowance for instrumental errors.

In principle, the test apparatus shall not be adjusted to maintain a limiting value of the tolerance zone, even if its inaccuracy is so small as to ensure that this limiting value would not be exceeded.

Example — If the quantity is expressed numerically as 100 ± 5, the test apparatus shall be adjusted to maintain a target value of 100 making allowance for instrumental errors and shall *in no case* be adjusted to maintain a target value of 95 or 105 (*see also* Notes 1 and 2).

NOTE 1 — In order to avoid exceeding any limiting value on the items during the performance of the test, it may be necessary in some cases to set test apparatus near to one tolerance limit.

NOTE 2 — In the particular case, where the quantity is expressed by a nominal value with a unilateral tolerance (which is generally deprecated unless justified by special conditions, for example, a non-linear response), the test apparatus should be set as close as possible to the nominal value (which is also a tolerance limit) taking account of the inaccuracy of measurement, which depends on the apparatus used for the test (including the instruments used to measure the values of the parameters).

Example — If the quantity is expressed numerically as :

$$100_{-5}^{\;0}$$

and the test apparatus is capable of an overall inaccuracy in the control of the parameter of ± 1, then the test apparatus should be adjusted to maintain a target value of 99. If, on the other hand, the overall inaccuracy is ± 2·5, then the adjustment should be to maintain a target value of 97·5.

9.2 Quantity Expressed as a Range of Values

Examples:

a) From 15 to 35°C,

b) Relative humidity from 80 to 100 percent (which can also be written as relative humidity ≥ 80 percent), and

c) From 1 to 2 h.

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*Basic environmental testing procedures for electronic and electrical items.

The expression of a quantity as a range of values indicates that the value to which the test apparatus is adjusted has only a small influence on the result of the test.

Where the inaccuracy of the control of the parameter (including instrumental errors) permits, any desired value within the given range may be chosen. For example, if it is stated that the temperature shall be from 15 to 35°C, any value within this range can be used (but it is not intended that the temperature should be programmed to vary over the range). In fact, the writer of the test intends that it should be carried out at normal ambient temperature.

TABLE 1 OUTLINES OF TESTS AND DEGREES OF SEVERITIES

(*Clause* 0.6.1)

TEST DESIGNATION	TEST	SEVERITIES		
		Component Type Items	Equipment Type Items	Additional Severities (Common to Both Component Type and Equipment Type Items)
(1)	(2)	(3)	(4)	(5)
A. Cold				
Aa	For non-heat-dissipating item with sudden change of temperature	Temperature (°C) — 65 — 55 — 40 — 25 — 10 Duration (h) 2	Temperature (°C) — 65 — 55 — 40 — 25 — 10 + 5 Duration (h) 2 4 16	Temperature (°C) Nil Duration (h) 72 96
Ab	For non-heat-dissipating item with gradual change of temperature			
Ad	For heat-dissipating item with gradual change of temperature			
B Dry heat				
Ba	For non-heat-dissipating item with sudden change of temperature	Temperature (°C) 500 315 250 200 100 85 70 Duration (h) 16	Temperature (°C) — — — — 70 55 40 Duration (h) 2 4 16	Temperature (°C) 1 000 800 630 175 Duration (h) 72 96
Bb	For non-heat-dissipating item with gradual change of temperature			
Bc	For heat-dissipating item with sudden change of temperature			
Bd	For heat-dissipating item with gradual change of temperature			
Ca	Damp heat (steady state)	Duration (days) 56 21 4	Duration (days) 56 21 4	Duration (days) 10
D	Damp heat (cyclic) : *16 + 8 h	—	40°C Severity 1 cycle	

*Test designation under consideration.

(*Continued*)

TABLE 1 OUTLINES OF TESTS AND DEGREES OF SEVERITIES—*Contd*

TEST DESIGNATION	TEST	SEVERITIES							
		Component Type Items			Equipment Type Items			Additional Severities (Common to Both Component Type and Equipment Type Items)	
(1)	(2)	(3)			(4)			(5)	
Db	12 + 12 h	55°C Severity 6 cycles 2 cycles 1 cycle			a) 55°C Severity 6 cycles 2 cycles 1 cycle b) 40°C Severity 56 21 12 6 2				
Z/AD	Temperature/humidity cyclic (moisture resistance)	10 cycles			—			—	
E Impact									
Ea	Shock	a) Half Sine Pulse			a) Half Sine Pulse			a) Half Sine Pulse	
		Acceleration (m/s^2)	Duration (ms)		Acceleration (m/s^2)	Duration (ms)		Acceleration (m/s^2)	Duration (ms)
		30 000	0·2		1 000	6		10 000	1
		15 000	0·5		750	11		2 000	3
		10 000	0·5		400	18		2 000	6
		5 000	1		300	11			
		1 000	6		300	18			
		750	6		150	11			
		500	11		120	11			
		300	11						
		300	18						
		b) Saw Tooth			b) Saw Tooth			b) Saw Tooth	
		Acceleration (m/s^2)	Duration (ms)		Acceleration (m/s^2)	Duration (ms)			
		1 000	6		1 000	11			
					1 000	6			
					750	11			
					400	11			
					400	18		—	
					200	11			
		c) Trapezoidal Pulse			c) Trapezoidal Pulse			c) Trapezoidal Pulse	
		Acceleration (m/s^2)	Duration (ms)						
		1 000	6						
		500	11						
		300	11						
		300	18						
Eb	Bump	Acceleration (m/s^2)	Duration (ms)	No. of Bumps	Acceleration (m/s^2)	Duration (ms)	No. of Bumps		
		400	6	4 000	400	6	4 000	—	
		250	6	1 000					
Ec	Drop and topple	Height of Fall (mm)			Height of Fall (mm)				
		—			100 50 25			—	
Ed	Free fall	Height of fall (mm)			Height of Fall (mm)				
					1 000 500 250 100 50 25			—	

(*Continued*)

TABLE 1 OUTLINES OF TESTS AND DEGREES OF SEVERITIES—*Contd*

TEST DESIGNATION	TEST	SEVERITIES: Component Type Items	SEVERITIES: Equipment Type Items	SEVERITIES: Additional Severities (Common to Both Component Type and Equipment Type Items)
(1)	(2)	(3)	(4)	(5)
Ed	Repeated free fall	No. of Falls 1 000 500 200 100 50	—	—

NOTE — The underlined values are preferred.

F Vibration

(1)	(2)	(3) Frequency Range (Hz	(3) Amplitude (Peak) Displacement/Acceleration	(3) Duration of Testing h	(4) a) Frequency Range (Hz)	(5)
Fc	Vibration, sinusoidal	10-55	0·75 mm	6	1-10	
		10-150	0·75 mm or 100 m/s^2	10	5-35	
		10-500	0·75 mm or 100 m/s^2	10	10-55	
		10-2 000	0·75 mm or 100 m/s^2	10	10-150	
		10-2 000	0·75 mm or 150 m/s^2	10	10-500	
		10-2 000	0·75 mm or 200 m/s^2	10	10-2 000	
		10-2 000	0·75 mm or 500 m/s^2	10		
					b) *Amplitude displacement* — As in relevant specification	
					c) *Acceleration,*— As in relevant specification	
					d) *Duration* — As in relevant specification	

(1)	(2)	(3)	(4)	(5)
Fd	Vibration (random)	Under consideration	Under consideration	
Ga	Acceleration (steady state)	Acceleration (m/s^2) 200 500 1 000 2 000 5 000 10 000 20 000 50 000 100 000 200 000 300 000	Acceleration (m/s^2)) Under consideration	—
J	Mould growth	a) Test for checking ability to grow mould 28 days b) Test for checking damage arising from mould growth 84 days	a) Test for checking ability to grow mould 28 days b) Test for checking damage arising from mould growth 84 days	

(*Continued*)

TABLE 1 OUTLINES OF TESTS AND DEGREES OF SEVERITIES — *Contd*

TEST DESIGNATION	TEST	SEVERITIES		
		Component Type Items	Equipment Type Items	Additional Severities (Common to Both Component Type and Equipment Type Items)
(1)	(2)	(3)	(4)	(5)
K	Corrosive atmosphere:			
	*Salt Mist, Variant A	Under consideration	a) Exposure to salt atmosphere 2 h at 15-35°C	—
	*Salt Mist, Variant B		b) Exposure to humid atmosphere 7 days at 40°C at RH 90-95 percent	—
			c) Number of cycles 3 4	—
L	Dust and sand*	Applicable	Applicable	
M	Low air pressure	Pressure (kPa)	—	—
		0·15 15·0		
		1·0 30·0		
		2·0 46·5		
		4·4 53·3		
		7·2 60·0		
		8·5 70·0		
		11·5 84·0		
	*High air pressure	Applicable	Applicable	—
N	Change of temperature	Applicable	Applicable	—
Na	Rapid change of temperature, two-chamber method			
Nb	Change of temperature, one-chamber method			
Nc	Rapid change of temperature, two-bath method			
Q	Sealing			
Qa	Sealing of bushes, spindles and gaskets	Applicable	Applicable	—
Qc	Container sealing, gas leakage	Applicable	Applicable	
Qd	Container sealing, seepage of fiilling liquid	Applicable	Applicable	
Qk	Hermeticity by tracer gas method with mass spectrometer	Applicable	—	
Qe	Penetration of liquid by bomb pressure test	Applicable	—	
Qf	Immersion	Depth (m)	Depth (m)	
		$\underline{15}$	265	
		$\underline{10}$	15	
			$\underline{10}$	
		$\underline{6}$	$\underline{6}$	
		$\underline{4}$	$\underline{4}$	
		$\underline{1·5}$	$\underline{1·5}$	
		$\underline{1}$	$\underline{1}$	
		0·40	0·40	
		0·15	0·15	
	*Hermeticity by radio active tracer gas method	Applicable	—	

NOTE — The underlined values are preferred.

Ra1	Driving rain	Applicable	Applicable	—
S	Radiation			
Sa	Solar radiation	Applicable	Applicable	—
	*Nuclear radiation	Under consideration	Under consideration	—

*Test designation under consideration.

(*Continued*)

TABLE 1 OUTLINES OF TESTS AND DEGREES OF SEVERITIES — *Contd*

Test-Designation	Test	Severities: Component Type Items	Severities: Equipment Type Items	Severities: Additional Severities (Common to Both Component Type and Equipment Type Items)
(1)	(2)	(3)	(4)	(5)
T	Soldering			
Ta	Solderability	a) Solder bath at 253°C	—	—
		b) Soldering iron at 350°C	—	—
		c) Solder globule at 235°C	—	—
Tb	Resistance to soldering	a) Solderability at 260°C	—	—
		b) Soldering iron at 350°C	—	—
U	Robustness of terminations			
Ua1	Tensile	Applied Force (N) 40 20 10 5 2·5 1	—	—
		Duration (s) 10 ± 1	—	—
Ua2	Thrust	Applied Force (N) 8 4 2 1 0·5 0·25	—	—
		Duration (s) 10 ± 1	—	—
Ub	Bending	Severities a) One bend immediately followed by a second bend in the opposite direction	—	—
		b) Two bends in the same direction	—	—
Uc	Torsion	Severities a) Three rotations of 360° each	—	—
		b) Two rotations of 180° each	—	—
Ud	Torque	a) Termination with threaded studs or screws	—	—

Nominal Thread Diameter (mm)	Torque (Nm) Severity 1	Torque (Nm) Severity 2
2·6	0·4	0·2
3	0·5	0·25
3·5	0·8	0·4
4	1·2	0·6
5	2·0	1·0
6	2·5	1·25

Test-Designation	Test	Component Type Items	Equipment Type Items	Additional Severities
		b) Non-wire Rigid Termination (Value of Torque)	—	—

Equivalent Diameter (mm)	Torque (Nm)
up to 1·6	8
1·7 to 3·2	56·5
3·3 to 4·8	127·1
4·9 to 7·9	282·5
8·0 to 12·7	565·0
Greater than 12·7	As in relevant specification

(*Continued*)

TABLE 1 OUTLINES OF TESTS AND DEGREES OF SEVERITIES — *Contd*

TEST-DESIGNATION	TEST	SEVERITIES		
		Component Type Items	Equipment Type Items	Additional Severities (Common to Both Component Type and Equipment Type Items)
(1)	(2)	(3)	(4)	(5)
XA	Resistance to cleaning solvents and permanence of markings	Applicable	Applicable	—
	*Fine mist			
Ra2	Drip proof			—
	*Explosion			

*Test designation under consideration.

APPENDIX A

(*Clause* 7.1)

COMPONENT CLIMATIC CATEGORY

A-1. The very large number of possible combinations of tests and severities may be reduced by the selection of a few groupings in the relevant component specification.

A-2. To assist in this selection and to provide a reasonable basic code which will indicate generally the climatic conditions for which components are suitable, the following is recommended.

A-3. The climatic category is indicated by a series of three sets of digits separated by oblique strokes corresponding respectively to the temperatures, both cold and hot, and the number of days of exposure to damp heat (steady state) they will withstand, as follows:

a) First set — Two digits denoting the minimum ambient temperature of operation (cold test).

b) Second set — Three digits denoting the maximum ambient temperature of operation (dry heat test). Where the temperature requires the use of only two digits, they shall be prefixed by the figure '0' to make up the three-digit group.

c) Third set — Two digits denoting number of days of the damp heat (steady state) test (Ca). Where the duration requires the use of only one digit, it shall be prefixed by the figure '0' to make up the two-digit group.

A-4. In order to belong to one category, components shall fulfil the requirements of the relevant specification when subjected to the whole set of tests specified for their category number in the relevant specification.

A-4.1 To belong to the category 55/100/56, a component shall satisfy at least all the following tests:

a) Cold	—55°C
b) Dry heat	+100°C
c) Damp heat (steady state)	56 days

A-4.2 To belong to the category 25/085/04, a component shall satisfy at least all the following tests:

a) Cold	—25°C
b) Dry heat	+85°C
c) Damp heat (steady state)	4 days

A-4.3 To belong to the category 10/070/21, a component shall satisfy at least all the following tests:

a) Cold	—10°C
b) Dry heat	+70°C
c) Damp heat (steady state)	21 days

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